REPORT OF THE COMMITTEE

ON

Advances in Chemistry, Pharmacy, Materia Medica, and Therapeutics.

(J. W. MALLET, M. D., University of Virginia, Chairman, etc.)

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SOME SOURCES OF DANGER IN THE ADMINISTRATION OF CHLOROFORM.—Reporter, J. Spotswood Wellford, M. D., Richmond, Va.

In endeavoring to discharge that portion of the duty of the Committee which has been assigned to myself (Advances in Materia Medica), the natural embarrassment arises of speaking of materia medica apart from therapeutics, chemistry, and pharmacy. When these are thrown out, there only remains the botanical description and the commercial history, for even the tests of the purity of the several articles necessarily involve the chemical relations of the article.

But, regarding the duty of your Committee to be much more allied to the practical than to the theoretical, your reporter has deemed it better to throw aside a mere enumeration of the articles which are now under trial by the profession, and which have not yet attained the rights of citizenship, nor acquired any recognized position even among the secondary class of the Pharmacopœia. In lieu thereof, he has considered that he could more usefully subserve the purposes of the Society by attempting to discuss some points of a subject, vast in its proportions, but full of interest to every practitioner, and one in which there are very variant opinions held in different sections of our own country. He therefore proposes to discuss some of the sources of danger in the administration of chloroform for anæsthetic purposes.

From the fact that ether was originally used in Massachusetts for anæsthesia, the Northern surgeons employ almost exclusively that article, and some writers of that section—especially Stillé—denounce the use of chloroform in most unmeasured terms. On the other hand, nearly all the Southern surgeons who served in the Confederate army give the preference to chloroform. During the war, owing to the difficulty of procuring articles through the blockade, and the comparatively small quantity of chloroform requisite, it was universally used; and consequently, our medical men having become

experienced in its management, have, with almost entire unanimity, continued its use in their private practice. In military surgery there is much less doubt of its safety, as there is always the presence of actual pain, which is the best antagonist to the dangerous effects of chloroform.

It is generally admitted that, in childhood and obstetrics its use, in careful and experienced hands, is as nearly safe as any other article of the materia medica of equal potency and benefit. In the large Children's Hospital in Paris it has been used for many years without one single fatal case having been reported. In obstetrics, it has been claimed that we have the reports of at least two million cases where it has been used successfully, and as yet have our medical journals reported only some four or five fatal cases—but not one in the hands of a professional man—and even these can be accounted for on some other satisfactory ground. Therefore, in these two classes, it may be assumed that the balance may be fairly claimed to be in favor of the use of chloroform over the other principal anæsthetic, ether. It is undoubtedly true, that deaths have been produced by the inhalation of chloroform, even in the practice of careful and skillful men, and even sometimes by the administration of comparatively small quantities. But it is also admitted that ether has produced death, and that the after consequences from its use are more injurious than are those from chloroform, as the recovery from the latter is more speedy and entire than from the other. Assuming the premises that the benefit from the relief of pain, and the actual decreased mortality in surgical operations, by the use of anæsthetics is so generally and universally admitted, that some article of this kind will be used; and that but for the larger number of deaths reported from its use, chloroform would be preferred over ether, it becomes a very important question whether many of the fatal results were not of preventible origin. To this question an affirmative answer can be given, and a close investigation of our current literature will show that the number of fatal cases is annually diminishing.

The first danger which can be removed is with regard to the purity of the article itself. When first introduced, a large portion of what was then used was undoubtedly impure. The Pharmacopœia recognizes chloroformum venale as an article of commerce, but gives no direction for its preparation, only directing a formula for its purification, leaving manufacturers to prepare it in the mode they may deem most economical. This is unfortunate; for, in an article so universally used and so liable to dangerous contamination, sufficient reliance cannot be placed on the tests of its purity to ensure safety.

Chloroform is obtained by the action of chlorine on alcohol, and is chemically the terchloride of formyl. Now, pyroxylic spirit, produced by the destructive distillation of wood, forms a series of chemical bodies, exactly corresponding to those formed by the same chemical agencies with alcohol.

Therefore, there is produced a methylic chloroform as well as a normal or ethylic chloroform, as that obtained from alcohol is denominated. Their anæsthetic action is the same, but the methylic is liable to contain six (6) per cent. of a dangerous empyreumatic oil, while the normal article has only one-fifth of one per cent. This is very important, as it is probable that a large proportion of the deaths caused by the inhalation—especially in its first introduction—may have been occasioned by this contamination, particularly in the hands of English surgeons, as a very large quantity of this methylic chloroform is prepared and sold in that country. There is no tax in this country or England on pyroxylic spirit, but a very onerous one on alcohol, and consequently there is a very considerable difference in cost. The only two cases of serious results which have occurred in the observation of your reporter were produced by this methylic chloroform during the war, when a considerable amount of it was furnished to the Confederate army. The Pharmacopœia gives a formula for *chloroformum purificatum*, and this is the only article which should be used for inhalation. It contains about 10 minims of alcohol to the ounce, to preserve it from decomposition. It is also very important that the specimen should be obtained from a reliable manufacturer, and the great exemption of Richmond city, where chloroform is universally used as the anæsthetic, from any serious accidents, is due to the fact that only that furnished by Dr. Squibb, of Brooklyn, is ever employed for inhalation. In every case where any doubt as to the entire purity of the specimen is entertained, it should be subjected to the usual tests before it is administered. A very simple test for the presence of this oil, which is most probably fusel oil or amylic alcohol, and is an active poison when inhaled, is to pour a small quantity on the hand, and if, in evaporation, there remains the slightest unpleasant odor, the specimen should be at once rejected as unfit for internal use. The presence of this oil may be better detected by the addition of an equal volume of pure sulphuric acid, which produces no change with a genuine article, but causes with the oil a color varying from yellow to a reddish-brown.

So much for the danger from an impure article. Let us now see if there have not been many of the reported deaths occasioned by an improper mode of administration, and may not this danger be averted.

First, no form of apparatus, in the opinion of your reporter, should be ever used. It has been satisfactorily proved that animal life cannot be maintained in an atmosphere containing a greater impregnation of chloroform vapor than 3½ to 4 per cent. Chloroform contains no oxygen, while ether does, being itself an oxide of ethyl. Now, to produce etherial anæsthesia, it is absolutely necessary to prevent the entrance of atmospheric air, and compel the patient to breathe only pure ethereal vapor. The system is able to exist in the amount of oxygen thus obtained, and consequently one is compelled

to use large quantities of the article. If you were to pursue the same plan with chloroform, you would inevitably produce the death of your patient by suffocation or pure asphyxia, and all the more readily because he was somewhat anæsthetized, and was, therefore, unable to make the necessary effort to obtain relief; consequently, any one accustomed to the use of ether should be aware of the difference of application, or he might unwittingly cause a fatal result. This is no fancied suggestion, for some of the reported deaths read like cases of asphyxia, and occur from too small doses of chloroform and too suddenly to receive any satisfactory explanation otherwise. Too frequently the operator, anxious to save time, places the sponge too close to the patient's nose, and thereby the fatal result is due to suffocation—only hastened, but not caused, by the chloroform. Most of the cases of reported death occur before the operation has been commenced and frequently when only one or two drachms of the article have been exhibited. In England an apparatus, either the one suggested by Dr. Snow, or some modification, is frequently used. It certainly saves an expenditure of the remedy, but at serious risk of life. Indeed, Anstie, in an extremely interesting work, states that the only fatal case which he has witnessed was due, in his opinion and that of Dr. Snow, to the condition of the inhaler, which was out of order; and further, that in 21 cases where alarming symptoms occurred in 3,058 administrations, 5 were cases where inhalers were used, and in all the others it was exhibited without any adequate provision having been made "for the regulation of the strength of the vapor inhaled."

The best and safest mode, but not the most economical, in the opinion of your reporter, is the stiff or starched napkin, so fastened as to render the large orifice always open, and without any sponge to prevent the unrestricted ingress of air. The napkin should be gradually brought towards the nose, so the patient may not only become accustomed to the vapor, but also because the chloroform acts very differently in proportion as it is introduced into the system. Dr. Marion Sims and some others have expressed the opinion that the unfavorable effects of the remedy were primarily produced by anæmia of the brain; but the contrary belief has been almost established by others, and more especially by Anstie, who has laid down as one of his conclusions that, differing from the regular and progressive extinction of the vital properties of the nervous system produced by ether, "two distinct lines of narcotic impression may be traced in the action of chloroform upon the animal organism, the development of the one or the other depending entirely on the rapidity with which the arterial circulation becomes charged with the narcotic agent. When the impregnation of the blood takes place with *moderate* rapidity, the sympathetic system is the *ultimum moriens*, and death begins at the lungs. When, on the contrary, the circulation becomes *rapidly* charged with a large proportion of chloroform, the narcotic effect may fall with such force on the sympathetic nerves as to extinguish their vitality.

The greatest possible importance attaches to this distinction; for one of the consequences of the *latter* occurrence is the production of instantaneous paralysis of the heart." And he goes on to argue that this sequence is proved by the production of glycosuria, or artificial diabetes mclitus, by the long-continued use of anæsthetics; and that the great danger in chloroform narcosis is the paralysis of the heart, which is evidenced by the blanching of the countenance and the failure of the pulse. Admitting this conclusion, the symptoms relied on by Nelaton, Sims, and others, to prove that anæmia of the brain would only indicate that, as the heart failed to produce the proper supply for the brain, of course that organ would indicate the deficiency. However we may explain the symptoms, the treatment that they propose still remains advisable, viz: to reverse the position of the body, with the head the most dependent portion, so that gravity may aid the weak and failing heart, and thereby cause a flow of blood to the brain. This mode of reasoning accounts satisfactorily for the fact that death has so frequently occurred from the inhalation of such small quantities, viz: the exclusion of atmospheric air has permitted the patient to breathe a vapor so heavily charged with chloroform vapor that the sympathetic nerves were overpowered and the heart ceased to act, and that the death was due to heart paralysis. To remove this, the greatest danger in the production of anæsthesia, the best plan is to premise the inhalation, as was the almost universal habit in the Confederate army, by the exhibition of a moderate quantity of alcoholic stimulant; tben see that the vapor breathed is not in a larger amount than 3.5 to 4 per cent. of chloroform; to commence gradually to impress the system, and by no means to be so anxious to hasten the effect as to exclude an over supply of fresh air. Ether produces naturally a greater amount of intoxication, and therefore there is less danger of this overwhelming effect on the sympathetic nerves; but, on the other hand, you have such violence from the preliminary excitement as frequently to forbid its use. In case of threatened cardiac syncope, inhalations of ammonia, alcohol, with hypodermic injections of atropia, and inversion of the body, would be the best antidote. If accessible, the galvanic battery would be of great service.

This action on the sympathetic nervous centres also explains another source of danger, and perhaps the one which has produced very nearly one-half of all the reported cases of death. It has been observed that the last portions of the body anæsthetized are the ano-genital region and the matrix of the great toe. In the list of 21 cases where alarming effects were produced which is reported by Anstie—and nearly every other list will furnish the same, if not a larger, proportion—10 were for operations on the penis, labia, rectum, perineum or great toe. Indeed, the assertion may be safely made that this class of cases has furnished the larger number of deaths, and, therefore, greater care should be here exhibited than in any other class of operations. Here, perhaps, it would sometimes be advisable to give the